

What is claimed is:

- 1 1. A coder comprising:
 - 2 an obtaining unit that obtains a predetermined
 - 3 amount of image data in which each pixel is expressed by a
 - 4 plurality of bits;
 - 5 a developing unit that develops the pieces of bit
 - 6 data in the image data on virtual planes, wherein pieces
 - 7 of bit data of the same pixel are developed on the same
 - 8 virtual plane; and
 - 9 a coding unit that performs entropy coding on the
 - 10 developed bit data in virtual plane units.
- 1 2. The coder according to Claim 1, wherein the pixel
- 2 is expressed by 8 bits.
- 1 3. The coder according to Claim 2, wherein the
- 2 developing unit develops pieces of bit data of each pixel
- 3 in a 2 bit by 4 bit matrix.
- 1 4. The coder according to Claim 1, wherein the
- 2 predetermined amount of image data is image data
- 3 corresponding to one page.
- 1 5. The coder according to Claim 1, wherein the coding
- 2 unit obtains a probability value of a target bit from

3 reference bits and performs an arithmetic coding with
4 prediction according to the obtained probability value,
5 wherein the target bit is a subject of coding and the
6 reference bits are in predetermined positions relative to
7 the target bit.

1 6. The coder according to Claim 1, wherein the
2 developing unit performs code conversion on the
3 predetermined amount of image data before developing the
4 pieces of bit data.

1 7. The coder according to Claim 6, wherein binary
2 data is converted to gray codes in the code conversion.

1 8. A coder comprising:
2 an obtaining unit that obtains a predetermined
3 amount of image data in which each pixel is expressed by a
4 plurality of bits;
5 a BTC (Block Truncation Coding) processing unit
6 that performs BTC processing on the obtained image data to
7 obtain gradation characteristic data and quantized data;
8 a developing unit that develops pieces of bit data
9 in the obtained gradation characteristic data on virtual
10 planes; and
11 a coding unit that performs entropy coding on the
12 developed bit data in virtual plane units.

1 9. The coder according to Claim 8, wherein the
2 developing unit performs code conversion on the obtained
3 gradation characteristic data before developing the pieces
4 of bit data.

1 ~~8~~ 10. A coding method comprising:
2 an obtaining step for obtaining a predetermined
3 amount of image data in which each pixel is expressed by a
4 plurality of bits;
5 a developing step for developing the pieces of bit
6 data in the image data on virtual planes, wherein pieces
7 of bit data of the same pixel are developed on the same
8 virtual plane; and
9 a coding step for performing entropy coding on the
10 developed bit data in virtual plane units.

1 11. A coder comprising:
2 an obtaining unit that obtains a predetermined
3 number of pixels of multivalued image data;
4 a BTC processing unit that generates gradation
5 characteristic data and quantized data from pixel values
6 of the pixels of the obtained multivalued image data;
7 a developing unit that develops pieces of bit data
8 in the gradation characteristic data on first virtual
9 planes; and

10 a coding unit that performs entropy coding on the
11 developed bit data in first virtual plane units.

1 12. The coder according to Claim 11, wherein
2 the developing unit develops pieces of bit data in
3 the quantized data on at least one second virtual plane,
4 and

5 the coding unit performs the entropy coding on the
6 developed bit data in the quantized data in second virtual
7 plane units.

1 13. The coder according to Claim 12, wherein each
2 piece of the quantized data corresponding to a different
3 one of the pixels includes a plurality of pieces of bit
4 data,

5 the coder further comprising a dividing unit that
6 divides the pieces of bit data in the quantized data into
7 a plurality of groups, wherein the developing unit
8 develops pieces of bit data in the quantized data in a
9 different group on a different virtual plane.

1 14. The coder according to Claim 13, wherein the
2 plurality of groups are a first group of upper bit data
3 and a second group of lower bit data.

1 15. The coder according to Claim 13, wherein

2 the predetermined number of pixels indicates a
3 block of 4 pixels * 4 pixels, and

4 the developing unit develops pieces of bit data in
5 each of the groups obtained from each block of the
6 multivalued image data in a 4 bit by 4 bit matrix.

1 16. The coder according to Claim 12, wherein each
2 piece of the quantized data corresponding to a different
3 one of the pixels includes a plurality of pieces of bit
4 data,

5 the coder further comprising:

6 a compression ratio obtaining unit that obtains a
7 compression ratio for the entropy coding; and

8 a judging unit that judges whether another
9 quantized data is necessary according to the compression
10 ratio.

1 17. The coder according to Claim 11, wherein the
2 developing unit performs code conversion on the pieces of
3 bit data in the gradation characteristic data before
4 developing the pieces of bit data in the gradation
5 characteristic data.

1 18. The coder according to Claim 17, wherein binary
2 data is converted to gray codes in the code conversion.

1 19. The coder according to Claim 11, wherein each
2 pixel is expressed by 8 bits in the multivalued image
3 data.

1 20. The coder according to Claim 11, wherein the
2 predetermined number of pixels indicates a block of 4
3 pixels * 4 pixels.

1 21. The coder according to Claim 20, wherein the
2 developing unit develops the pieces of bit data in the
3 gradation characteristic data obtained from each block of
4 the multivalued image data in a 4 bit by 4 bit matrix.

1 22. The coder according to Claim 11, further
2 comprising a converting unit that converts the quantized
3 data into a predetermined bit string, wherein the coding
4 unit performs the entropy coding on the bit string.

5 23. A coding method comprising:
6 an obtaining step for obtaining a predetermined
7 number of pixels of multivalued image data;
8 a BTC processing step for performing BTC
9 processing on pixel values of the pixels of the obtained
10 multivalued image data and generating gradation
11 characteristic data and quantized data;
12 a developing step for developing pieces of bit

13 data in the gradation characteristic data on virtual
14 planes; and
15 a coding step for performing entropy coding on the
16 developed bit data in virtual plane units.

1 ⁹24. An image forming apparatus comprising:
2 a coder that includes:
3 an obtaining unit that obtains a predetermined
4 amount of image data in which each pixel is expressed by a
5 plurality of bits;
6 a developing unit that develops the pieces of bit
7 data in the image data on virtual planes, wherein pieces
8 of bit data of the same pixel are developed on the same
9 virtual plane;
10 a coding unit that performs entropy coding on the
11 developed bit data in virtual plane units;
12 a decoder that decodes data that has been coded by
13 the coder and reconstructs image data; and
14 an image forming unit that forms an image using
15 the image data that has been reconstructed by the decoder.

1 25. An image forming apparatus comprising:
2 a coder that includes:
3 an obtaining unit that obtains a predetermined
4 number of pixels of multivalued image data;
5 a BTC processing unit that generates gradation

6 characteristic data and quantized data from pixel values
7 of the pixels of the obtained multivalued image data;
8 a developing unit that develops pieces of bit data
9 in the gradation characteristic data on first virtual
10 planes;
11 a coding unit that performs entropy coding on the
12 developed bit data in first virtual plane units;
13 a decoder that decodes data that has been coded by
14 the coder and reconstructs image data; and
15 an image forming unit that forms an image using
16 the image data that has been reconstructed by the decoder.

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1 26. A computer program that performs coding processing
2 of image data has a computer execute steps, the steps
3 comprising:
4 a developing step for developing on virtual planes
5 pieces of bit data in image data in which each pixel is
6 expressed by a plurality of bits, wherein pieces of bit
7 data of the same pixel are developed on the same virtual
8 plane; and
9 a coding step for performing entropy coding on the
10 developed bit data in virtual plane units.

1 27. A computer program that performs coding processing
2 of image data has a computer execute steps, the steps
3 comprising:

- 4 an obtaining step for obtaining a predetermined
- 5 number of pixels of multivalued image data;
- 6 a BTC processing step for generating gradation
- 7 characteristic data and quantized data from pixel values
- 8 of a plurality of pixels of multivalued image data;
- 9 a developing step for developing pieces of bit
- 10 data in the gradation characteristic data on virtual
- 11 planes; and
- 12 a coding step for performing entropy coding on the
- 13 bit data in virtual plane units.